

is included, concerning every substance discussed. This first volume deals with the solid elements, with the inorganic compounds of a non-saline character, such as oxides, sulphides, and phosphides, and with the halogen salts, cyanides and salts of the recently discovered nitrogen acids. The second volume is to deal with the inorganic oxy- and sulpho-salts and the remaining inorganic crystalline compounds, while the third and fourth volumes are to treat of the organic compounds. The arrangement of the text is that each group is described, as regards its general characteristics, in an introductory statement in large type, and this is then followed by the detailed description of each member of the group in smaller type.

An excellent *résumé* of the crystallography of the naturally occurring minerals is given, but it is the detailed crystallography of the substances requiring to be prepared chemically, and the descriptions of which cannot be found elsewhere except by reference to the widely scattered original memoirs, that renders the book so priceless, for it presents the essential results of all chemico-crystallographical investigations right up to date. The illustrative figures of crystals are neat and clear, and the text easy, the large type even luxurious, to read.

One important feature has been left to the last to refer to, namely, that the symmetry of the crystals of each substance dealt with is given in accordance with the much more scientific method of classification recently adopted as the outcome of the completion by Schönflies, Fedorow, and Barlow of the geometrical theory of homogeneous structures, which enables the particular individual class represented in the substance under discussion to be at once identified from among the thirty-two possible classes of crystal symmetry.

In conclusion, with regard to the contents of this book, the best of all possible praise can conscientiously be bestowed in saying that it is worthy of the mastermind that conceived it.

A. E. H. TUTTON.

A NEW WORK ON ORGANIC EVOLUTION.

The Analysis of Racial Descent in Animals. By T. H. Montgomery, jun. Pp. xi+311. (New York: Henry Holt and Company; London: George Bell and Sons, 1906.) Price 10s. 6d. net.

IT would be a most fascinating task to trace the evolution of modern methods of dealing with the problems of life. Differentiation has taken place so extraordinarily quickly. The time is long past when one man can attempt to grapple with the whole problem. Not only so, but the time seems to be past when one man can even be interested in the whole problem. Evolutionists may be broadly classified into those to whom the problem of evolution is the problem of the origin of species and those to whom it is the problem of adaptation. The key-note of de Vries's "Mutationstheorie" is the solution of the problem of species; we even go so far as to say that this is the achievement of de Vries's work. The logical conclusion, the complete working out of the theory of

natural selection, is reached in Dr. Archdall Reid's "Principles of Heredity." The interest of the two authors is entirely different. De Vries's interest is in the origin of species, Dr. Reid's in natural selection. Darwin's interest was in both; if we look no further than the title of his chief work we can see this—"On the Origin of Species by Means of Natural Selection."

The fact that these two interests have segregated, and the way in which they have segregated, are both very suggestive, and the direction in which they point is the same. The fact of segregation suggests that the association of the two ideas was unnatural, and that they were not capable of union. The way in which they have segregated confirms this suspicion. For those who devote their attention to the question of species reject natural selection, while those who elaborate the theory of natural selection find no support in the phenomenon of specific difference. All possibility of a reconciliation between the divorced ideas is put an end to by Meyrick, who probably knows more about specific difference than anyone else. In his handbook of British Lepidoptera he says that, in seeking for the most suitable characters by which species may be distinguished, those which can in any way be regarded as useful to the species must be discarded without more ado.

It is not surprising that Darwin's work should have borne fruit which segregated in this way. The case is thoroughly Mendelian. Darwin's work was a cross between a biological theory of evolution and a social and industrial theory of competition. The hybrid, more vigorous than either parent, took the world by storm. We are now witnessing its posterity separating out more or less simply into the two forms which were united in the beginning. Just as every plant in the F_1 generation contains yellow and green peas, and just as it is not until the next that there can be found plants bearing only yellows or only greens, so Darwin's interest was in the "Origin of Species by Natural Selection," while now we find de Vries, who is absorbed entirely with the former, and Reid entirely with the latter.

The immediate result of Darwin's work was the flood of energy which spent itself in tracing out the genealogical histories of organisms. To such lengths did the students of phylogeny go, so remote from reality did their speculations become, that the study of phylogeny has fallen into discredit in the eyes of a great many of those who are looked up to as biological thinkers to-day.

Prof. Montgomery's interest is centred neither in species nor in selection, but in phylogeny. He admits that phylogeny has been discredited by the indiscretion and shallowness of a number of its exponents, but he contends that if we limit ourselves to the strictly experimental method we are neglecting an enormous range of phenomena.

"For living organisms are in number and variety hardly commensurate with the vast assemblage of their ancestors. Are we then to leave out of consideration all this once existing life, simply because

its units are no longer subject to experiment? Most assuredly not."

Our author undertakes the herculean task, we venture to think successfully, of setting the study of phylogeny on a surer foundation. The reason that phylogenetic inquiry has become discredited is that the majority of biologists are neither so stupid that they are content to dabble with phylogeny nor clever enough to make it a great and fruitful sphere of inquiry—a field fit for the exercise of the highest intelligence.

The experimental method has its limitations no less than its fascination. It is not merely a paradox to say that in biology those things with which we can experiment most are those which to the organism matter least. The reason is that we are not the first to start experimenting. Nature has been there before. For example, the range of continuous variation in an organism may either be the direct result of the constitution of the living substance or it may have been determined by the most stringent selection acting since life dawned. If, therefore, we institute experiments on variation—for example, the determination of the effect of heat on the range of variation—we may either be studying one of the simple properties of protoplasm or discovering the limits within which natural selection allows the particular organism dealt with to vary under the conditions of heat, *e.g.*, to which we subject it. The really fundamental processes do not lend themselves to experiment. That is how they have become fundamental. Everyone who wishes to train himself to study them should read Prof. Montgomery's book.

There are a few trifling misprints, *e.g.* "embryoning" in the table of contents; and Mendel worked, not with the sweet, but with the culinary pea.

A. D. D.

ELECTRIC RAILWAYS.

Electric Railway Engineering. By H. F. Parshall and H. M. Hobart. Pp. xxiv+475. (London: Archibald Constable and Co., Ltd., 1907.) Price 42s. net.

THE authors of this work have already introduced a series of technical works upon dynamo design and kindred subjects, and Mr. Hobart is also known as the author of a recent work upon the steam turbine.

In the present volume the authors deal with a wider range of subjects, and, in short, treat of the whole question of heavy "electric traction," that is, traction as applied to railways rather than to street tramways. Such a book was required, and will be welcomed by the growing class of engineers who wish to add to their experience of steam railway work some knowledge of electrical engineering, which is more and more coming to invade the field of traction.

Technical works of this kind may, as a rule, be divided into two classes; on the one hand are the highly technical works which deal with the more scientific aspects of the subject, and of which the

authors' "Dynamo Design" is an example; on the other are the entirely practical works which, at their worst, degenerate into collections of specifications. The present volume endeavours, not unsuccessfully, to combine these two, and to give the reader a clear knowledge of the fundamental principles that underlie the application of electricity to haulage, illustrations of the methods employed in carrying this into effect, and actual examples and details of construction. What it does not fully supply, and what, unfortunately, books of this kind very seldom contain, are the commercial results obtained from the adoption of electric traction. It may be said that this is outside the scope of an engineering treatise; and if the work is to comprise engineering in the sense in which that word was commonly used during the last century the answer is justified, for the engineer of those days was concerned with the question of "will it work?" rather than the question of "will it pay?" But the engineer of the twentieth century has become more and more obliged to look upon the latter as the test of successful engineering, and until a book can be produced dealing with electric traction from the operating point of view such works will not, it is to be feared, have much effect in influencing railway authorities to replace steam haulage by electric traction. Apart from these limitations, however, the present volume is most valuable, for although a considerable portion of the matter has been already published in one form or another, there was a great need for bringing together all that has been done and written.

The choice of the system to be adopted upon any particular part of a railway, although necessarily influenced by first cost, should ultimately be dependent upon its suitability for use upon the railway as a whole, and the results obtained from electrification must be judged in reference to the whole railway undertaking rather than in connection with one section. In connection with the vexed question of the relative advantages of direct current, single phase or three phase, the authors do not undertake to predict the form that the ultimate electric railway installation will assume, contenting themselves with pointing out the merits of each, and emphasising the fact that standardisation has been one of the great elements of success in steam railway working, and that the adoption of electric traction upon railways in the future will be slow until standardisation is adopted.

Coming now to the contents of the book itself, it consists of three parts, dealing respectively with the mechanics of electric traction, the generation and transmission of the electrical energy, and the rolling stock. Chapter i. deals with "tractive resistance at constant speed," and gives the results of applying both theoretical and arbitrary formulæ to the result obtained in actual practice.

Chapter ii. deals in a similar manner with the problem of acceleration. Many useful curves of acceleration, speed-time, and speed-distance are given. Chapter iii. deals with tractive force in relation to acceleration, while chapter iv. deals with the